VEGETATIVE FILTERS

DEFINITION

Vegetative filters are temporary or permanent sediment traps composed of cultivated or naturally occurring vegetation. Synonyms for vegetative filters include riparian zones, grass filter strips, and stream buffer zones. Riparian zones are vegetative buffers along the banks of a natural drainage way or stream.

PURPOSE

The purpose of vegetative filters is to provide areas for the deposition of runoff-transported materials before they reach drainage ways. These zones are especially useful in the protection of streams paralleling land disturbances.

REGULATORY REQUIREMENTS

405 KAR 16:060 and 18:060, Section II, require a 100-foot stream buffer zone unless a variance is granted by the Cabinet. Approval for such a variance is based upon the assurance that the water quality and quantity and the environmental resources of the stream will not be adversely affected. In addition, 405 KAR 16:180 and 18:180 require the protection and/or restoration of riparian areas.

IMPLEMENTATION

Vegetative filters are best employed in areas of moderate slope that receive sheet flow following storm events. Naturally occurring vegetative buffers with thick vegetation can be effective and economical sediment traps to buffer the effects of disturbances associated with haul roads and regraded spoil slopes. Application of fertilizer can help increase plant growth and density. See the section titled Revegetation (pg. 61-82) for further discussion.

Stream buffer zones can also be established with grass or woody plants, when ground cover is absent. Researchers associated with the University of Kentucky have developed a Kentucky Grass Filter Model. This model addresses the factors that influence the effectiveness of cultivated grass filters, namely:

- Length of the filter
- Filter slope
- Grass characteristics
- Size distribution of incoming sediment
- Quantity and depth of flow

Vegetative filters can be constructed with grading equipment commonly available on active mine sites. The filter is commonly at least 15 feet above diversions and 100 feet above naturally occurring streams. These figures are approximate and should be adjusted to accommodate unique features of the site and the filter itself.

Grasses used for filters should be selected on the basis of their root system and above-ground density. Deep root systems resist scouring, and dense, well-branched top growth is generally flood and drought resistant. Tall Fescue and Reed Canarygrass are effective grasses for use in filter strips. See the section titled Revegetation for information on seedbed preparation, seeding, and mulching considerations.

Computer software (e.g., SEDCAD$^+$ Version 3) is available for the purpose of evaluating site-specific characteristics, e.g., soil type, flow, grass stiffness, and filter length, width, and slope and projecting the sediment-trapping efficiency of the filter (Warner and Schwab, 1992).

MAINTENANCE

Sediment reduction effectiveness of cultivated filters diminishes over time as the vegetative filter becomes clogged with sediment. Until a permanent cover is established on adjacent disturbed areas, it may be necessary to reseed and establish a new filter strip periodically.

ROADS

ROADS

DEFINITIONS

For the purpose of coal mining operations, the term roads applies to surface right-of-ways intended for use by land vehicles used in coal exploration or surface coal mining and reclamation operations as well as activities associated with abandoned mine reclamation. A road consists of the entire area within the right-of-way, including the roadbed, shoulders, parking and side area, approaches, structures, ditches, surface, and contiguous appendages necessary for the total structure. The term includes access and haul roads constructed, used, reconstructed, improved, or maintained, including those used by coal-hauling vehicles leading to transfer, process, and storage areas. The term also excludes any roadway within the immediate mining pit (405 KAR 7:001).

PURPOSE

Roads are used within the context of surface coal mining operations in order to minimize the disturbance created by mining equipment and other transport vehicles.

REGULATORY REQUIREMENTS

Environmental regulations designed to minimize the amount of erosion and sedimentation incurred from roadways are addressed in 405 KAR 16:220. This regulation sets forth requirements for the location, design, construction, maintenance, and removal or permanent retention of roads and associated drainage structures.

IMPLEMENTATION

Roads should be located, insofar as is reasonably possible, on ridges or on the most stable slopes available. Roads on or near ridges are desirable because typically they require the fewest stream crossings. Flatter slopes not only reduce the erosive effects of runoff water, but also improve truck performance and driver safety. Slope stability is determined by both percent slope and an analysis of the overburden.

Unless otherwise authorized by the Cabinet, under no circumstances may roads be located in stream channels. Approved stream fords may not adversely affect stream sedimentation or fish and wildlife. Streams or natural drainage ways may not be relocated to accommodate road construction.

Roadbed Construction

Design specifications for road construction should be present in the MRP. Practices follow that are intended to limit hydrologic disturbance (405 KAR 16:220):

- **Roadway width** -- should be appropriate for traffic volume and the anticipated size, weight, and speed of vehicles. As a rule of thumb, straight-aways should be at least 23 feet wide for a single-land road and 40 feet wide for a two-lane highway. The roadbed should be up to 20 percent wider at curves depending on the sharpness of the curve. Dead-end roads should allow sufficient room for easy turn around.

- **Vertical Alignment** -- Maximum road grade should not exceed 15 percent (1v:6.5h), and within any 1000-foot stretch of road, no more than 300 feet may have a slope in excess of 10 percent.

- **Horizontal Alignment** -- should be consistent with existing topography.

- **Clearing and Grubbing** -- Vegetation should be limited to the width necessary to accommodate road drainage construction.

- **Road Cuts** -- Cut slopes should not be steeper than 1v:1.5h in unconsolidated materials or 1v:0.25 h in rock, unless a minimum safety factor of 1.5 can be demonstrated (and Cabinet approval is obtained).

- **Road Embankments** -- No organic material or soil should be placed beneath or within any embankment. This includes materials such as coal, coal blossom, peat, or frozen or excessively wet materials. Acid-producing materials may be used in the construction of embankments only for those roads constructed on coal processing waste banks.

  When slopes are planned to exceed 20 percent, ground should be plowed, stepped, or if on bedrock, keyed. The keyway should have a minimum width of 10 feet and should extend a minimum of two feet below the toe of the fill.

  The embankment should be constructed in horizontal layers, and compacted. The fill should be placed in layers 6 to 12 inches thick. Each layer should be compacted using tampers, sheepsfoot, or pneumatic tired rollers, or vibratory compactors. Compaction should be sufficient to support the anticipated traffic volume, weight, and speed. Slopes should not be steeper than 1v:2h, except where fill material is comprised of at least 85 percent rock. In those instances, slopes should not be steeper than 1v:1.35h.

- **Minimum Safety Factor** -- A minimum safety factor for all embankments is 1.25.

- **Toe Berm** -- Considerations should be given to constructing a toe berm at the base of fill slope. A toe berm should be pitched at 1 to 3 percent toward the slope. The outslope of the berm should not exceed 33 percent.

- **Slopes and Curves** -- The road surface should be sloped to prevent the ponding of water. The banking of curves allows for safer truck handling and less load spillage. A banking slope should be specified in the plans developed by an engineer and should be at least 0.5 inches per foot. The crossfall should run from the outside of the curve to the inside. Crossfalls and banking should be smooth and gradual to minimize ponding. Berms must be at least as high as the axles of the equipment scheduled for use on the roadway.

- **Sub-base and Surfacing** -- Good quality sub-base reduces road and equipment costs and minimizes the effects of erosive forces. Acceptable sub-base materials include crushed gravel, clean sand, and sand-clay mixture. Acid- or toxic-forming materials are unacceptable for use in road surfacing. The depth of sub-base depends on the material used (Table 4).

Table 4. Depth of Sub-Base Materials

Sub-Base Material	Depth (in)
Crushed Rock	6-8
Gravel	8-12
Clean Sand	12-24
Sand-Clay Mixture	10-30

Source: Derived from California Bearing Ratios

When selecting a sub-base depth, consideration should be given to both weight load and particle size. If the loaded equipment is heavier than 40 tons, the thicker depths in the ranges above should be used. If loads are lighter and the sub-base contains mixed-sized particles, the thinner depths should be used. In general, however, the thicker the sub-base the better in terms of hauling efficiency, especially under wet conditions.

The practice of laying rolls of plastic filter cloth between the road surface and sub-base promotes the drying of road surfaces. Rutting and erosion are reduced because the plastic filter cloth tends to increase traction and encourage the even spreading of the road surface.

Surface paving materials include rock, crushed gravel, and asphalt. Asphalt is costly and tends to be slick when wet or covered with mud. Crushed gravel is more cost efficient in terms of application and provides better traction for heavy equipment. Gravel or rock used for the sub-base should be crushed finer for use on the road surface. Neither the sub-base nor the surface should contain more than 10 percent fines.

Removing gravel from streambeds can be harmful to aquatic life and should be avoided. If coal is trucked to a power plant, the Cabinet may approve the hauling of cinders back for surfacing as long as acidic conditions do not exist. The surfacing material should have a compacted thickness not less than six inches. Compaction can be achieved with rubber-tired or steel rollers.

Drainage

Roads and associated structures should be designed to allow adequate drainage to accommodate a 10-year, 24-hour precipitation event as a minimum (see the MRP). Water-control systems may include ditches, cross drains, and ditch relief drains. Natural water drainage channels should not be altered or relocated for the sake of road construction. If the area above the road is disturbed, all runoff from the road should be collected by using roadside diversions. Roadbeds constructed on hilly terrain should have a drainage ditch running alongside (usually cut into the cut slope) and a berm or mound on top of the fill slope. On flat or gently sloping land, a diversion ditch is needed along each side of the road.

- **Crossfall** -- Roadbeds should be sloped toward roadside ditches. Roads cut into hilly terrain should have a side crown and one full-width crossfall (Figure 16). Roads on flat or gently sloping land should have a center crown and two crossfalls.

  The crossfall or cross-slope of the bed should be ¼ to ½ inch per foot. For example, on a single-lane, side-crown road, the fill slope side of the road would be about 6 to 12 inches higher than the cut slope side. In comparison, the crossfall on a road of the same width built on level land would be half of that or about three to six inches. Runoff would flow from the center of the road to ditches on either side. For information on ditch construction, see Diversions.

- **Drainage ditches** -- Drainage ditches should be placed at the toe of all cut slopes. Ditches should be constructed on both sides of a throughcut and on the inside shoulder of a cut-and-fill section. Ditch-relief cross drains should be spaced according to the grade. Water should be intercepted before reaching a switchback or large fill and drained away. Water accumulated in a fill or switchback should be released below the fill, through conduits or in riprapped channels, and should not be discharged onto the fill. Trash racks and debris basins should be installed in drainage ditches to keep the drainage system free from clogging. The use of settling basins and risers are practices that can further help to control siltation stemming from road drainage.

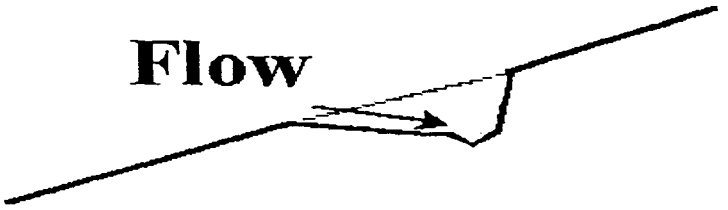

Figure 16. Roadbed crossfall on hilly terrain

- **Culverts** -- Drainage structures are required for stream channel crossings. Depending on the stream channel width and bank height, two or more culvert pipes side-by-side, may be required (Figure 17). Oval-shaped pipe is often more cost-effective than rounded pipe. Culverts should be long enough to run beneath the total width of the roadbed and both side slopes. Pipe diameter should be at least two feet. Culverts should be placed flush with the stream substrate, so as not to act as a barrier to aquatic organisms. Permanent bridges are recommended over culvert crossings (less damaging to stream substrate).

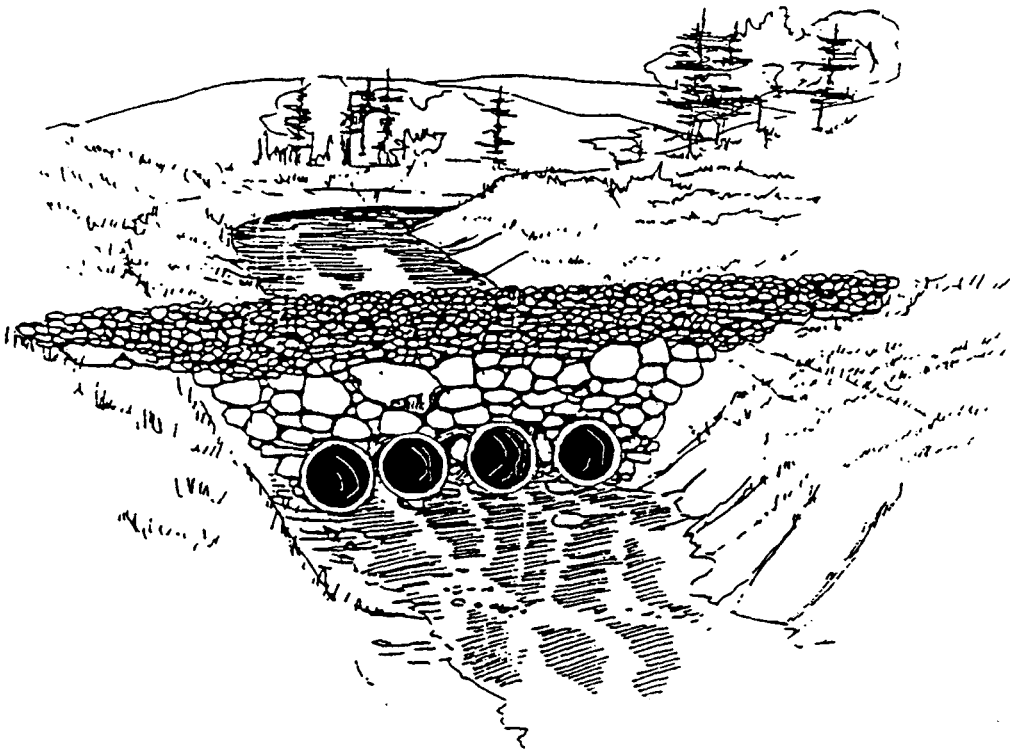

Figure 17. Constructing stream crossings by providing a culvert or bridge.

The stream bed should not be disturbed beyond that extent necessary. Culvert pipes should be laid on a slope of at least one-forth inch per foot (at least 2 to 4 percent slope) to ensure drainage. There should be no more than a one-foot gap between the outside edges of each pipe. After the pipes are placed in the stream, clean, fist-sized should be backfilled rock. Soil may not be used as a fill. All culverts should be covered with compacted fill to a minimum depth of one foot. A depth of one-half the pipe diameter is preferable (Figure 18.) Inlets should be protected from erosion by means of rock headwall. Culverts should be spaced more frequently as grade increases (Table 5).

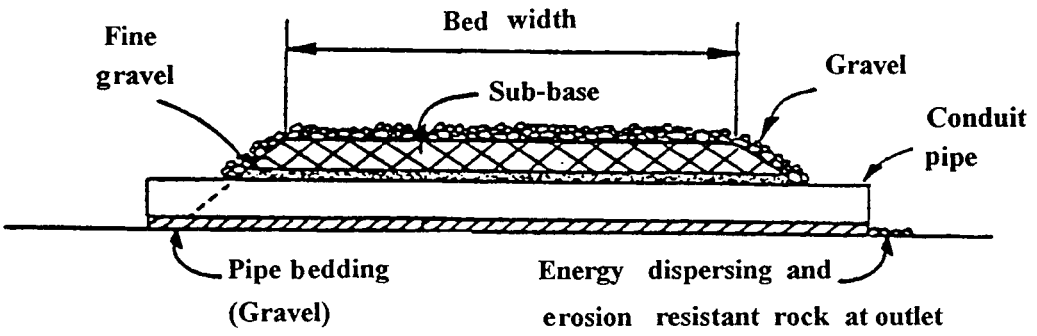

Figure 18. Cross-drain culvert construction

Table 5. Culvert Spacing with Grade

Culvert Spacing not to exceed	Percent Slope
1000 ft	0 to 3
800 ft	3 to 6
500 ft	6 to 10
300 ft	10 or greater

Source: Weigle, USDA Forest Service

On temporary crossings to be used no longer than six months, the upstream and downstream faces should be ripraped. Surface approaches for a distance of 25 feet with six inches of rough gravel. A four-inch concrete apron on both the upstream and downstream faces is recommended, together with an eight-inch reinforced concrete running surface (including 25 feet of both approaches).

Restoration

All roads within the permit area should be removed unless approved as part of the post-mining land use. Restoration should begin as soon as practical after the road is no longer needed for mining activities. To accomplish restoration:

- The road should be closed to all vehicular traffic. This can be accomplished using large boulders or logs.
- Roadbeds should be plowed, ripped, and scarified, starting at the top of the slope and working downward.
- Fill slopes should be returned to AOC by rounding or reducing slopes to conform to those of adjacent terrain.
- Cut slopes should be shaped to blend with natural terrain.
- Terraces should be constructed if necessary to prevent excessive erosion and to provide long-term stability in cut-and-fill slopes.
- Natural patterns should be restored.
- All bridges and culverts should be removed.
- Culverts should be replaced with cross drains, dikes, and water bars (Table 6).
- Roadbank surfaces should be topsoiled and revegetate. See Topsoil Redistribution and Revegetation.
- All road surfacing materials should be disposed of appropriately (see Noncoal Mine Waste).

Table 6. Water Bar Spacing

Road Grade	Spacing (ft)
2	250
5	135
10	80
15	60
20	45

MAINTENANCE

Road maintenance is essential for reducing operating costs and keeping roads safe and passable. Culverts and drainage systems should be checked on a regular basis to ensure that there are no obstructions that could lead to flooding or washouts. Inspections on a weekly basis are recommended. All systems should be checked following a rainfall event. Drainage ways should be cleared, as necessary. As ruts develop, the roadbed should be regraded and smoothed. Restoration should be completed, as appropriate.

TOPSOIL AND OVERBURDEN HANDLING

- Topsoil Removal and Storage
- Temporary Spoil Storage
- Backfilling and Grading
- Scarification
- Topsoil Redistribution
- Acid/Toxic Spoil
- Noncoal Mine Waste
- Excess Spoil Disposal

TOPSOIL REMOVAL AND STORAGE

DEFINITIONS

All topsoil, topsoil substitutes, and supplements for non-prime farmland uses and topsoil, and subsoil for prime farmland uses must be removed as separate layers from areas to be disturbed, segregated from other materials, and immediately redistributed or stockpiled pending redistribution.

PURPOSE

The purposes of removing and storing topsoil are these:

- To preserve media sufficient to sustain the approved postmining land use and to sustain vegetation that is adequate to meet the revegetation requirements of 405 KAR 16:200.
- To ensure stability in the foundations of structures built on surface mined lands such as excess spoil or coal mine waste piles and embankments constructed to impound water.

REGULATORY REQUIREMENTS

General requirements for topsoil removal and storage are outlined under 405 KAR 16:050. Soils from lands designated as prime farmland under 405 KAR 8:050, Section 3 must be removed and stored in compliance with 405 KAR 20:040.

IMPLEMENTATION

Removal of Woody Vegetation

Once erosion and sediment control structures are in place, trees, shrubs, and other woody vegetation must be removed before mine development can progress. Methods for tree removal are dependent on the slope of the terrain and the availability of equipment. Often it is convenient for the surface owner or operator to contract with a logging company to cut marketable timber. Unmarketable logs can be used for the construction of erosion control structures such as check dams (see Drainage). Information on logging companies and markets can be obtained from District Foresters (see Appendix D).

Remaining woody vegetation should be scalped. Slash can be chipped for use as mulch on reseeded areas. Windrowing or piling slash around the site is generally not a good practice. State regulation 405 KAR 16:060 prohibits disturbance within 100 feet of streams or other bodies of water to provide a buffer zone to filter sediment (see Vegetative Filters). Signs should be used to mark the boundary between buffer zones and disturbed areas.

Finally, tree stumps and roots must be grubbed out or provisions made to ensure their removal from the soil following soil replacement. The material should be disposed of in a designated location within the permit area. In heavily forested areas characterized by shallow soils, the problem of soil loss during grubbing may be significant. Care should be exercised to retain as much soil as possible.

Soil Removal

Following the removal of woody vegetation, the topsoil must be removed. In the case of lands that have herbaceous vegetation, these materials may be removed along with the topsoil. Topsoil is the richest, uppermost layer of soil, referred to as the A and E horizons (Figure 19). In some areas, especially the mountainous regions of Appalachia, the actual topsoil may be less than six inches thick. In these areas, the term "topsoil" is extended to include both the topsoil and the unconsolidated materials immediately below to

a total depth of six inches. Additionally, on a site-specific basis it may be necessary to remove the B horizon and portions of the C horizon if these are required to meet the revegetation requirements of 405 KAR 16:200 and to ensure soil productivity consistent with the approved post-mining land use. Bedrock or the D horizon lies below the subsoil and is also referred to as consolidated material. This may be weathered and removed without blasting.

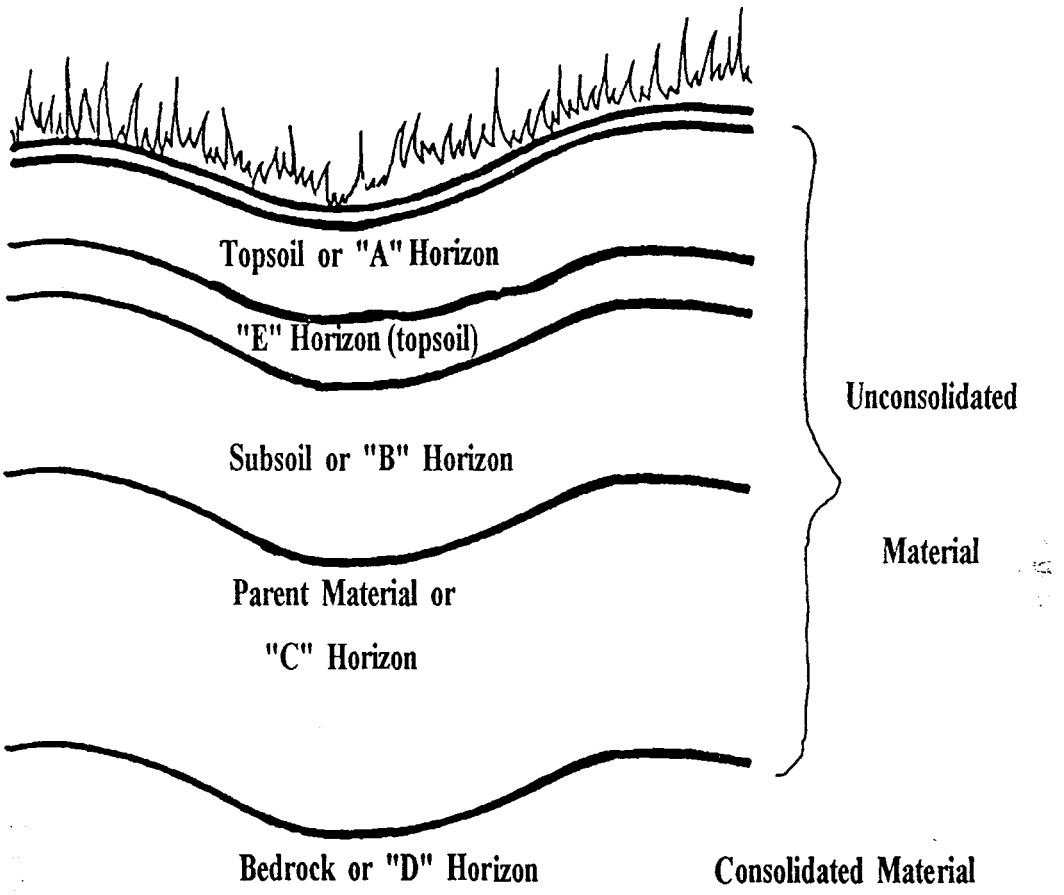

Figure 19. Schematic soil profile

Selected materials may be substituted for or used as a supplement to topsoil if it can be demonstrated that the resultant soil medium is equal to or more suitable for sustaining vegetation than the available topsoil and that it is the best available material to support vegetation. Considerations for selecting a topsoil substitute or supplement include:

- Volume.
- Physical and chemical characteristics:
  pH, net acidity or alkalinity, P, K, texture, and percent coarse fragments.
- Supplemental studies, if available.

In the case of lands designated as prime farmland, the removal of topsoil can be a somewhat more complex task. In such instances, it is necessary to remove and segregate the A, E, B, and C horizons to a restored depth of 48 inches. In order to achieve this goal, consider:

- Soil losses that may occur during handling when determining soil quantity to meet depth requirements.
- Information available through most recently published soil surveys, including maps and representative soil profiles.
- Flagging prime farmland soil boundaries on the site.
- Substitution of approved subsoil materials for fragipan horizons (horizon symbols containing "x") in order to improve chances for restoring productivity. These may be derived from appropriate associated non-prime subsoil horizons such as from soils designated by rule as being non-prime.
- The following types of equipment for use in soil removal to minimize compaction:
  - end-dump trucks
  - scrapers
  - wheel/conveyor.
- That soil removal should be performed under dry conditions, if possible, to minimize compaction.
- That combining B and C horizons with comparable horizons from scattered areas of prime farmland of the same soil type within the permit area is permissible as long as they are within the same ownership boundaries.
- The mixing of B and C horizons from the same or different soil types, although subject to regulatory approval, is a common practice.

Soil Storage

Soil should be stockpiled only when prompt redistribution is impractical (Figure 20). Otherwise, stockpiles should be constructed stable sites within the permit area. Stockpiles should be constructed using equipment that will minimize compaction (i.e., end-dump trucks, wheel/conveyors). If these sites occur on non-mined land, they should be prepared by removing all woody vegetation that may interfere with subsequent soil removal. Shallow slopes (not to exceed 1v:2h) minimize the effects of forces that cause erosion. Sloping the top of the stockpile upstream from the natural drainage may aid in providing adequate drainage in order to eliminate ponding. In the case of prime farmland soils, horizons A and E, B and C should be stockpiled separately. For stockpiles left in place more than 30 days, erosion control through the establishment of non-noxious, quick-growing annual and perennial plants (see Revegetation) is necessary.

In the case of long-term surface disturbances, soil may be distributed elsewhere within the permit area to enhance its use and condition as an alternative to stockpiling, if so approved. In all cases, topsoil should be redistributed as soon as possible.

MAINTENANCE

Soil stockpiles should be inspected on a regular basis, especially following significant rainstorms. Rill and gully erosion should be repaired and reseeding and mulching. Silt fences should be installed if necessary (see Silt Fences).

Figure 20. Soil storage

TEMPORARY SPOIL STORAGE

DEFINITIONS

This practice concerns the temporary stockpiling of spoil. Spoil is defined as overburden and other materials, excluding topsoil and subsoil, coal mine waste, and mined coal, that are excavated during coal surface mining and reclamation operations (405 KAR 7:001). Overburden (Figure 21) refers to material of any nature, consolidated or unconsolidated, excluding topsoil and subsoil, which lies above a natural deposit of coal (KRS 350.010).

PURPOSE

Temporary spoil storage offers an interim solution when displaced overburden cannot be immediately backfilled and regraded or otherwise permanently disposed. While temporary storage provides working space in the mine pit, it can necessitate the double handling of spoil.

REGULATORY REQUIREMENTS

As part of the mining and reclamation plan (405 KAR 8:030, Section 24) submitted with the permit application, the following must be included pertaining to the temporary storage of spoil:

- A narrative explaining the construction, modification, use, maintenance, and removal of overburden handling, transportation, and storage areas and structures.
- Locations of storage areas (to be marked on the MRP map).

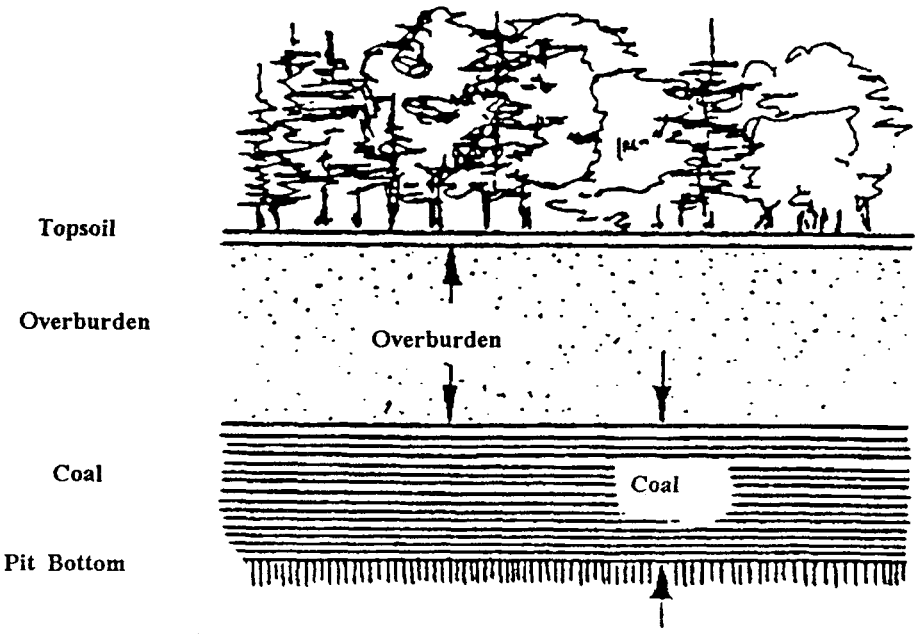

Figure 21. Typical surface mine cross-section before mining

IMPLEMENTATION

Site Selection

Sites for temporary spoil piles that are stable, with little or no slope should be selected . Areas containing seeps and springs or which are otherwise poorly drained should be avoided. Spoil piles should be located to minimize handling costs -- typically close to the final cut.

Topsoil Removal

Stable spoil pile construction depends on a firm foundation. For this reason, topsoil shouls be removed from intended spoil storage sites that occur on non-mined sites, and stored or redistributed (see Topsoil Removal and Storage).

Drainage Control

Diversions should be constructed around the base of the spoil storage site (see Diversions). Drainage should be tested for pH. All storage areas must drain to a sediment pond. Other temporary sediment barriers should be installed as necessary (see Silt Fence).

Construction

Temporary spoil storage piles must be designed by a qualified professional engineer. The specifications for pile construction will be outlined within the MRP. In general, spoil should be spread in horizontal layers and then compacted. Adequate compaction helps reduce the risk of acid drainage via percolation. Spoil placement should be avoided under wet conditions. Piles with relatively steep slopes should be terraced. The fill surface should be promptly seeded (see Revegetation). If parts of the pile have a good vegetative cover and others do not, new lifts should be laid on the bare surfaces, if engineering plans allow.

MAINTENANCE

Temporary spoil piles often have exposed areas from recent additions or subtractions of spoil. These exposed areas are susceptible to erosion and require close attention. Erosion damage to the grass cover, diversions, and silt fences should be repaired quickly. Refer to the appropriate Maintenance sections throughout the manual.

BACKFILLING AND GRADING

DEFINITION

Backfilling and grading (Figure 22) include those procedures used in replacing spoil into the pit or onto the bench and grading to approximate original contour (AOC) contemporaneously with coal extraction.

PURPOSE

Backfilling and grading is necessary to restore disturbed areas to their approximate original contour, to ensure stability and safety of regraded areas, to minimize soil erosion and water pollution, to promote revegetation, and to otherwise restore the hydrologic character of the site to pre-mining conditions compatible with the post-mining land use.

REGULATORY REQUIREMENTS

Requirements for backfilling and grading are set forth under 405 KAR 16:020, 16:190, and 20:060 and address highwall elimination, return to approximate original contour, timing of operations, use of terraces, thick and thin overburden conditions, burial of acid and toxic materials, and the regrading or stabilization of rills and gullies.

IMPLEMENTATION

Surface mining regulations require that all disturbed areas be backfilled and graded to the approximate original contour (AOC) unless a variance is approved by the Cabinet. This includes transporting and grading spoil and eliminating highwalls and spoil piles.

Unless otherwise approved, such activity must be performed contemporaneously with mining. Careful planning can limit double handling of spoil and thereby reduce operator costs. Regulatory time constraints on backfilling and final grading operations are presented in Table 7, by mining method.

Fig. 22. Backfilling and Grading

Table 7. Timing of Backfilling and Grading Operations

Mining Method	Starting at (day of)	Time (days)	Distance (linear feet) from First Cut
Area	Coal removal	180	4 spoil ridges (including current ridge)
Auger	Initial surface disturbance	60	1500
Contour	Initial surface disturbance	60	1500
Mountaintop Removal	Coal removal	180	N/A

Source: 401 KAR 16:020 Contemporaneous Reclamation

Before heavy earth-moving equipment can be removed from the site, backfilling and final grading of spoil must be complete. Within 30 days immediately following backfilling and rough grading, the area must be final graded, scarified, topsoil redistributed, and seeding completed. Time extensions may be granted if this schedule cannot be met for reasons outside the operator's control.

Furthermore, state regulations require that acid or toxic materials be buried by at least four feet of non-toxic material within 30 days of exposure. If such burial is not feasible within 30 days, the Cabinet may allow temporary storage if water pollution will not result.

Pit Dewatering

Water impounded in the pit must be removed before backfilling begins. Temporary topsoil, spoil piles, and/or natural barriers may not be removed or altered to aid in dewatering.

Water may be pumped or siphoned out in a controlled manner. Water that meets KPDES effluent quality standards can be discharged directly into natural waterways. Otherwise, the water will need to be routed to sedimentation ponds and treated.

Backfilling

In area mining, overburden should be removed with a dragline or other suitable equipment, and spoil material should be deposited directly behind the advance cut on the previously mined pit or bench. Spoil must be placed on solid ground. This system:

- Eliminates double handling, except in the case of that spoil removed from the first box cut or bench.
- Ensures that spoil is placed on solid ground.

Spoil from the first box cut may need to be temporarily stored and later transported to the final box cut, (see Temporary Spoil Disposal).

Contour mining in eastern Kentucky requires that spoil be hauled to a mined portion of the bench. Typical hauling distances for single-seam contour mines average 500 feet. The haul back method provides opportunity for the selective placement of spoil, e.g. in instances where acid spoil must be covered by at least four feet of fill,. (see Acid/Toxic Spoil).

Spoil must be transported, placed, backfilled, compacted (as necessary), and graded to eliminate highwalls, ensure a long-term static safety factor of at least 1.3, and achieve a post-mining slope that does not exceed the angle of repose and that does prevent slides. Excess spoil from contour mining is disposed of in head-of-hollow fills, (see Excess Spoil Disposal). The operator must not place the following materials on the downslope: spoil, waste, or vegetation or other debris.

If compatible with the postmining land use, cut-and-fill terraces may be allowed. Terraces must meet the following requirements:

- Highwall must be eliminated.
- Terrace bench must not exceed 20 feet in width.
- Terrace outslopes must not exceed a slope of 50 percent (1v:2h), unless otherwise approved.

Small depressions and/or impoundments, if approved, may be constructed on backfilled areas if they are suited to the approved postmining land use, do not adversely affect the stability of the fill, and are not located on steep-slope outslopes. Steep-slope mining is further regulated under 405 KAR 20:060 Steep Slopes. Steep slopes are those in excess of 20 degrees (Appendix G).

The postmining slope may vary from AOC if approval is obtained from the Cabinet for provisions for thin overburden, thick overburden, mountaintop removal mining, previously mined areas, steep slope mining, etc.

Grading

After spoil is dumped by truck or dragline, it must be graded to AOC. Grading to AOC requires that highwalls, temporary spoil piles, and depressions be eliminated unless otherwise approved by the Cabinet. The finished slope need not be constant from top to bottom nor precisely replicate the original terrain prior to mining. The goal is to leave as little slope as possible, yet still cover the highwall. Rough grading is most often accomplished using dozers. All final grading, including preparation of overburden before replacement of topsoil, topsoil substitutes, and topsoil supplements, and the subsequent placement of these materials shall be done along the contour to minimize erosion and instability later.

MAINTENANCE

See Scarification, Topsoil Redistribution, and Revegetation for information on maintenance. In general, where slopes permit, working along the contour will reduce erosion and slippage. Rills nine inches or deeper must be filled, regraded, and revegetated.

SCARIFICATION

DEFINITION

Scarification refers to those procedures or techniques used to prepare the regraded spoil surface for eventual topsoil redistribution and revegetation by gouging, ripping, disking, or other surface roughening.

PURPOSE

The purpose of scarification is to minimize surface water runoff and erosion. This is achieved by:

- Improving the bonding potential between the subsoil and the topsoil;
- Reducing compaction and increasing the ability of plant roots to penetrate the subsoil; and
- Increasing the movement of water from the topsoil to the materials below that in turn increase groundwater recharge.

REGULATORY REQUIREMENTS

Under 405 KAR 16:050, Section 4, the state mandates that prior to final placement of topsoil the land shall be scarified or otherwise treated to eliminate slippage surfaces and promote root penetration. Scarification may follow topsoil redistribution if the permittee can demonstrate no harm would result to materials and vegetation and approval by the Cabinet is granted.

IMPLEMENTATION

Excessive compaction of mine spoil often results from the movement of heavy earth-moving equipment such as scrapers and dozers used to backfill and grade sites to AOC. Surface roughening is a critical step to ensure adequate water infiltration and root penetration on the reclaimed land.

Liming

Lime should be applied to regraded spoil surfaces prior to roughening at rates consistent with lime recommendations for subsoils based on spoil test results (see Soil Amendments). Liming is important because it adjusts spoil pH to a range conducive to root development.

Surface Roughening

There are four common methods of surface roughening: ripping, scarification, dozer basins, and tracking. These methods differ in limitations, effectiveness, and equipment requirements. Most equipment can be used safely on slopes up to 30 percent. On slopes in excess of 30 percent, tracked vehicles are needed. If possible, roughening should be done along the contour to minimize erosion and slippage. On steep slopes where operating equipment along the contour is dangerous, a dozer should be driven up and down the slope; cleat or track marks will be created along the contour, thereby trapping some runoff and sediment.

Ripping

A single or multiple shank ripper will be necessary in severely compacted areas. Rippers are also used where grooves deeper than 17 inches are desired. Some single ripper shanks mounted on a ripper bar and attached to a crawler tractor may cut to a depth of three to four feet. Multiple shank rippers may also be used but will not cut as deep. Triple shank rippers mounted on four-foot centers yield two- to three-foot deep cuts, although channel density increases.

Scarification

Some lightly compacted soils may require only scarification. Special scarifying equipment is available, but chisel or disk plows can be used.

Dozer Basins

Dozer basins are created by mounting a V-shaped blade onto a bulldozer and dragging it across the ground intermittently. Dozer basins are seven to eight feet long and two to three feet deep on 15 to 20 foot centers. A driver can roughen approximately 2 to 2.5 acres per hour on gently sloping land. The 220 to 280 basins per acre store 1.5 to 2 acre-inches of runoff water. Application of this method requires Cabinet approval.

Tracking

Tracking is the simple operation of running a tracked dozer up and down a steep slope. Cleat marks left from the dozer are along the contour and aid in reducing runoff, soil erosion, and seed loss.

MAINTENANCE

Topsoiling and seeding should be done as soon as possible to minimize the amount of erosion damage that may require repair (see Topsoil Redistribution and Revegetation).

TOPSOIL REDISTRIBUTION

DEFINITION

This practice refers to the redistribution of topsoil and topsoil substitutes/supplements from a designated temporary storage area and/or coincidentally with topsoil removal. In the case of prime farmland land uses, it also refers to the redistribution of subsoil in addition to the topsoil.

PURPOSE

Soil and soil substitutes/supplements are redistributed to provide a medium adequate to comply with the revegetation requirements of 405 KAR 16:200 or to ensure soil productivity consistent with the approved post-mining land use.

REGULATORY REQUIREMENTS

Required topsoil redistribution practices are addressed in 405 KAR 16:050 Section 4. For lands designated as prime farmland, soil replacement requirements are detailed in 405 KAR 20:040, Section 5.

IMPLEMENTATION

Following scarification, prior to bond release, topsoil and/or topsoil substitute and supplemental materials must be placed on all surfaces that have been disturbed by mining, including access roads, stream diversions, and excess spoil disposal sites.

Land mined, backfilled, graded, and scarified should be topsoiled and revegetated as soon as possible. To avoid double handling of topsoil, the reclamation operation should be planned so that topsoil redistribution is accomplished in tandem with topsoil removal to the extent possible. That is, topsoil removed from the area of the advance cut is immediately distributed on land already mined, backfilled, graded, scarified, and limed (if necessary).

Heavy equipment used to redistribute topsoil materials can cause excessive compaction. Compaction impairs the ability of plant roots and water to penetrate the soil, which in turn causes increased levels of runoff and erosion. Topsoil redistribution is best accomplished by using trucks (base level dumping) and spreading with low-ground-pressure dozers. Returning the soil in parallel windrows with trucks or scraper pans and spreading between the windrows with wide-blade or low-pressure dozers may also be a satisfactory alternative (SCS, 1986).

Redistributing topsoil during wet periods should be avoided because this may result in greater soil compaction or otherwise diminish soil quality. Heavy equipment traffic should be kept to a minimum on reconstructed soils. All traffic areas should be ripped or chiseled.

Topsoil should be spread evenly to achieve a uniform thickness for each horizon segregated (see Topsoil Removal). Low spots or depressions should not be left.

Topsoil must be reconstructed to a minimum depth of six inches. On lands designated as prime farmland, the combination of topsoil and subsoil must be reconstructed to a minimum depth of 48 inches unless otherwise approved (405 KAR 20:040). B and/or C horizons or other approved substitute soil material must be redistributed to a thickness not less than the combined average thickness of the original unmined B and/or C horizons or to a depth of 42 inches, which assumes the replacement of six inches of topsoil (or less if a qualifying restrictive layer existed).

MAINTENANCE

Reclaimed areas should be checked periodically for signs of erosion. Tracking with a dozer or application of mulch will provide temporary protection. Rills and gullies should be regraded, if formed, and reseeding should be done as soon as possible.

ACID/TOXIC SPOIL

DEFINITIONS

Acid-forming materials are those for which the potential acidity of the material exceeds its neutralization potential. Toxic-forming materials are defined as those for which the potential acidity exceeds the neutralization potential of a spoil mixture by at least 5.0 tons $CaCO_3$/1000 tons of material. Also toxic-forming are those materials that could potentially release chemicals in toxic quantities to surface or ground water supplies.

PURPOSE

The identification, selective handling, and/or burial of potentially acid- and/or toxic-forming spoil is a crucial preventive measure for protecting surface and ground water quality.

REGULATORY REQUIREMENTS

Requirements for the identification of acid- and toxic-forming materials are addressed under 405 KAR 8:030, Section 13, Baseline Geologic Information. Should toxic materials be present, a Toxic Materials Handling Plan is required as part of the MRP. Prescribed remedial actions are outlined in 405 KAR 16:060 and 16:190. Acid- or toxic-forming spoil must be covered within 30 days of first exposure unless otherwise approved.

IMPLEMENTATIONS

The following BMPs are designed to prevent or minimize the formation of acid mine drainage (AMD). Acid mine drainage contains iron and sulfate pollutants (pg. 6). The chemical reaction that produces this drainage occurs much faster in the presence of the iron-oxidizing bacteria Thiobacillus ferrooxidans and Thiobacillus sulfooxidans. The resulting low pH environment can cause metals such as aluminum and manganese to leach into water supplies. Preventive BMPs are outlined below.

An acid-base account employing volume-weighted averages of the neutralization potential and potential acidity of overburden strata may be used to determine if overburden materials may become "toxic." If not toxic, yet acid-forming, selective blending of the disturbed strata would be prescribed before all the material is replaced in order to neutralize any potentially acid-forming effects.

If the overburden is found to be "toxic," the Toxic Materials Handing Plan from the MRP should be followed. Such a plan would require the toxic-forming materials be possibly treated and covered with a minimum of four feet of non-acid, non toxic-forming material. Such burial should not be in proximity of a drainage way because it could cause or pose a water pollution threat.

If specified in the permit, additional measures to reduce the oxidation potential of disturbed strata may be required:

- Application of limestone to neutralize acid spoil.
- Compaction.
- Selective placement to minimize contact with surface and ground water.
- Encasement in low-permeability substances.
- Installation of finger drains, French drains, or relief wells.

Cover with more than four feet may be necessary as determined on a case-by-case basis to protect against the upward migration of salts, exposure via erosion, or other local conditions.

Pit Dewatering

Some water will enter the pit as precipitation and/or ground water. Surface mining activities should be planned and conducted to prevent the accumulation of such water. Any water that does not accumulate must be removed by pumping, siphoning, or an otherwise controlled manner to a natural or constructed drainage way. Sedimentation ponds provide a means for treating pit water, which has come into contact with coal or acid spoil near the coal seam. Other acid drainage treatment methods are discussed earlier in this manual (p. 10-15). Dewatering the pit is a critical opportunity for point source treatment of non-point source water pollutants.

In no event should water from pit dewatering be discharged directly to a stream without being determined in compliance with KPDES permit effluent limitations (401 KAR 5:065). Pumping and siphoning water from pits are point source discharges that are subject to KPDES self-monitoring and reporting requirements unless they pass through a sediment structure prior to discharge to surface water.

Selective Handling

Selective handling of overburden strata is best achieved with scrapers, front-end loaders, and trucks. Stripping shovels and draglines are generally inadequate for separating strata on a small-scale basis. The MRP could call for placing alkaline spoil beneath, above, and/or mixed with acid spoil.

Burial

Burial and consolidation of acid spoil is the most cost-effective method for preventing AMD. If the disposal site is above the water table, the MRP will require that acid spoil be buried in some combination with alkaline spoil. The acid spoil should be dumped into the disposal site in one-foot thick layers. If required by the MRP, mix crushed agricultural limestone in with each layer. Each layer should be compacted , if required.

The disposal site should be covered with four feet of non acid-forming, non-toxic forming, non-combustible materials within 30 days of exposure. These materials are best applied in one-foot thick layers and compacted, if required. Installing a layer of clay over the entire disposal area should be considered. The final surface should be graded so no depressions or low spots remain. Otherwise, puddling could occur that might promote seepage and infiltration of water into the toxic material. The installation of finger drains, French drains, or relief wells may be useful to direct water away from areas where toxic/acid spoil is buried.

MAINTENANCE

Monitor water quality as necessary. Treat mine drainage for excess solids, metals, and lowered pH, if indicated. See Mine Drainage Treatment. Suspect overburden materials should be routinely analyzed in order to isolate toxic/acid strata. Preventive measures can then be taken to prevent AMD seeps.

NON-COAL MINE WASTE

DEFINITIONS

Non-coal mine wastes include, but are not limited to, grease, lubricants, paints, flammable liquids, garbage, abandoned mining machinery, lumber, and other combustibles generated during surface mining activities.

PURPOSE

Environmentally sound storage and disposal practices for wastes other than coal mine waste, soil, or rock are necessary to adequately protect surface and ground water supply.

REGULATORY REQUIREMENTS

The storage and disposal of non-coal mine waste are regulated under 405 KAR 16:150. Disposal of hazardous and solid waste other than "coal mining solid waste" (as defined by regulations of the Kentucky Division of Waste Management) shall not be conducted on the permit area unless a permit is obtained from the Kentucky Division of Waste Management.

IMPLEMENTATION

At no time may non-coal mine waste be deposited in a refuse pile or impounding structure. Nor may any excavation of non-coal mine waste be performed within eight feet of any coal outcrop or coal storage area.

Storage

Storage of these materials must be in a controlled manner in a designated portion of the permit area such that leachate and runoff do not degrade surface and ground water quality. The area must be designed to prevent the chance of fires from developing via selective layering, sealing, and compacting as necessary. The area must be built to remain stable and suitable for reclamation and revegetation compatible with the natural surroundings.

Disposal

Final disposal of non-coal mine wastes shall be designated for a disposal site within the permit area or a state-approved solid waste disposal site. Disposal sites within the permit area shall be designed and constructed to ensure that leachate and surface runoff from the site does not degrade the surface or ground water supplies. Wastes shall be routinely compacted and covered to prevent combustion and wind-borne waste. When the disposal is completed, a minimum of two feet of soil cover must be placed over the site, slopes stabilized, and revegetation accomplished (405 KAR 16:150).

MAINTENANCE

Rills nine inches or deeper must be filled, regraded, and revegetated. Diversions should be inspected following significant rainfall events and properly maintained (see Diversions).

EXCESS SPOIL DISPOSAL

DEFINITIONS

Excess spoil is mined overburden left over after the mine site is otherwise graded and restored to AOC. Durable rock spoil has a Slake Durability Index of 90 or greater as determined by the Kentucky Department of Transportation's Method for Determination of Slake Durability Index (Kentucky Method 64-513-79).

PURPOSE

Drainage control and construction practices that ensure stability of excess spoil disposal sites are essential for achieving the restoration and reclamation of all surface areas affected by mining activities.

REGULATIONS

Practices related to the disposal of excess spoil are regulated under 405 KAR 16:130. This regulation pertains to the general considerations of design certification, stability, spoil placement, drainage, and inspections. The design and construction of valley fills, head-of-hollow fills (Figure 23), rock-core chimney drains, end-dump fills, and disposal on unreclaimed pre-existing benches are addressed.

IMPLEMENTATION

Excess spoil should be disposed of in a controlled manner in order to:

- Minimize the adverse effects of leaching and surface water runoff.
- Ensure mass stability.
- Ensure final fill is suitable for reclamation to the approved post-mining land use.

In order to minimize the handling/transport costs, excess spoil is usually backfilled directly onto or trucked to disposal areas. Valley fills and head-of-hollow fills are frequently used methods for disposal in eastern Kentucky in order to address the difficulty of disposing of excess spoil on mountainous terrain. End-dumped fills of durable rock spoil may be approved by the Cabinet as an alternative method of disposal. Where they exist, and if approved by the Cabinet, it may be possible to use pre-existing benches for disposal of spoil.

Major steps and considerations in the planning and construction of excess spoil disposal areas include:

- Site Selection/Preparation
- Drainage Control
- Fill Construction
- Inspection

Site Selection/Preparation

Regulations dictate that disposal areas be located on the most moderately sloping and naturally stable areas available within the permit area and, if possible, on natural terraces or pre-existing benches if such placement provides additional stability and prevents mass movement. Vegetative and organic material should be removed from the site via scalping and grubbing. Topsoil should be removed, segregated, and stored and/or redistributed prior to excess spoil placement. (Vegetative material may be used for mulch and/or incorporated with topsoil materials if approved by the Cabinet.)

If the fill will rest on an area that has a natural slope in excess of 2.8h:1v (36 percent), keyway cuts (excavations to stable bedrock) and/or rock toe buttresses should be constructed to anchor the fill and ensure its stability. Dimensions of cuts and buttresses should be specified in the MRP as designed by a professional engineer.

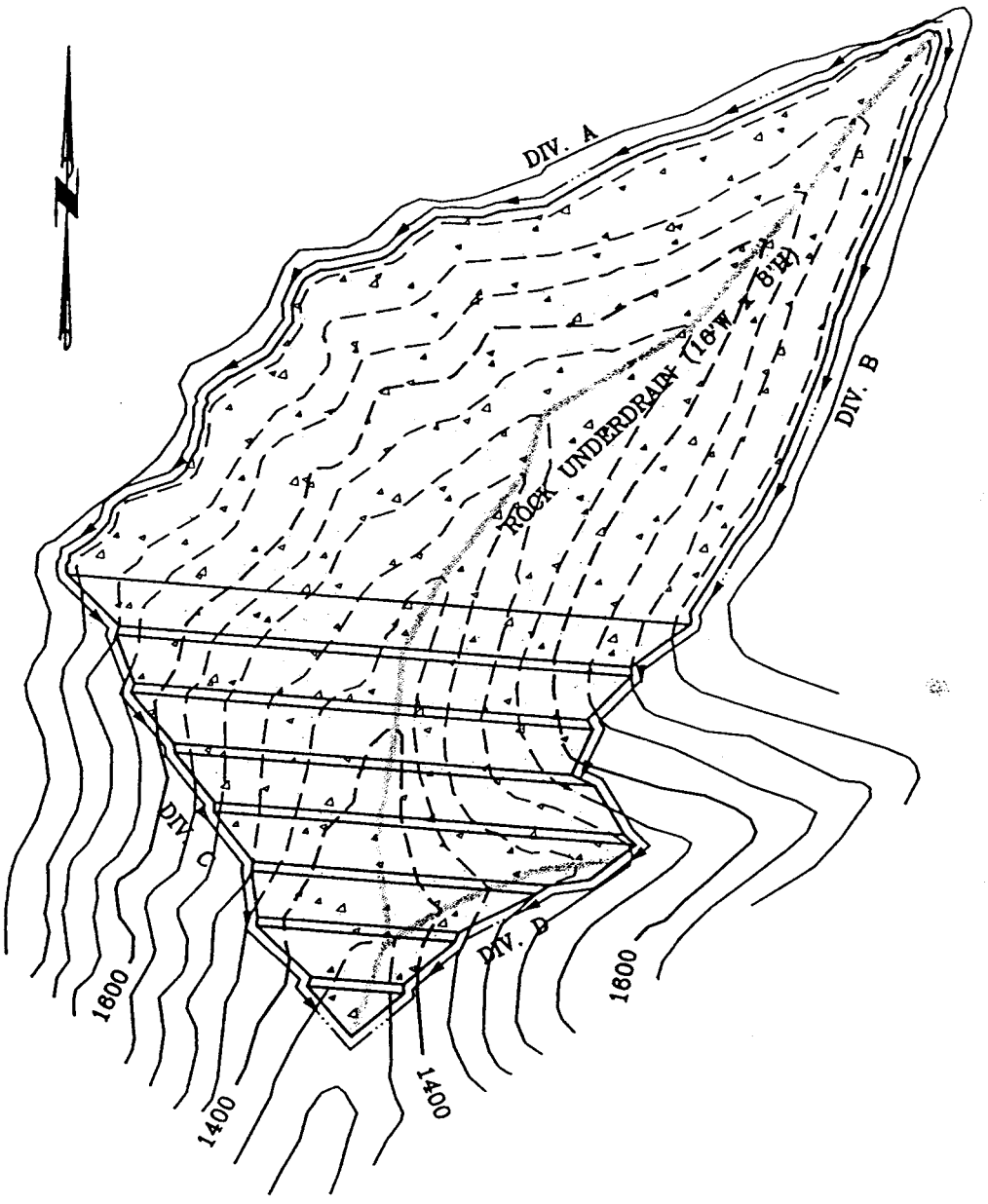

Figure 23. Head-of-hollow fill

Drainage Control

Diversions. Prior to any disturbance of the disposal site, drainage from above and adjacent to the site must be diverted to a sedimentation pond in order to control erosion. Diversions should safely drain runoff from above a nearby fill to accommodate a 100-year, 24-hour storm event. Only in cases when spoil is to be disposed of on pre-existing benches may this design requirement be altered to 10-year, 24-hour storm event. All diversions should be designed to minimize the infiltration of water into the fill and ensure fill stability. Bench diversions are built along the toe of each outslope and direct runoff to lateral drains along the sides of the fill. Lateral drains are constructed before filling operations begin. Surface diversions continue to be built as filling operations continue.

Rock Underdrains. Underdrains are constructed in advance of fill construction and must be composed of durable (SDI $\geq$ 95), nonacid-forming, nontoxic-forming rock. Materials must be adequately sampled and analyzed under the direction of a professional engineer to certify these requirements have been met. Underdrains are used to drain water from the fill that originates from springs, man-made or natural drainage ways, wet-weather seeps, and seeps due to precipitation. Surface runoff uphill from the fill may not be diverted under or through the fill, except in the case of rock-core chimney drains. Underdrains should be constructed along the natural drainage paths of valley or hollow fills.

The design specifications of underdrains should be contained within the MRP. These specifications should be sufficient to carry away from the fill the maximum anticipated water seepage and discharge in the foundation area. The minimum cross-sectional dimensions of the underdrain are specified in Table 8, unless otherwise approved. Construction requirements demand that no more than 10 percent of the rock be less than 12 inches in diameter and no single rock be larger than 25 percent of the width of that segment of the underdrain in which the rock is located. Underdrain design should contain a filter system to protect the system from piping and contamination and ensure long-term functioning.

Table 8. Minimum Drain Segment Cross-sectional Dimensions

Total cumulative volume of fill material to be drained by segment	Predominant type of fill material	Minimum size of drain segment in feet	
		Width	Height
Less than 1,000,000 yd^3	Sandstone	10	4
	Shale	16	8
More than 1,000,000 yd^3	Sandstone	16	8
	Shale	16	16

The underdrain may be divided into segments for purposes of determining required dimensions of the individual drain segments. Each segment will drain the volume of fill overlying the segment plus carry the water drained to the segment from areas of the fill located upstream of the segment. Where the cumulative volume of the fill material to be drained by a segment is less than 1,000,000 yd^3, the smaller dimension may be used.

Source: 405 KAR 16:130 Appendix A.

Work should begin by digging trenches where runoff naturally flows. They may be dug in the same configuration as a trapezoidal diversion (see Diversions). The underdrain may then be constructed into the trench in either of two ways:

1) Wrapped Drain. The trench bottom and sides should be lined with filter cloth, (see Silt Fences). Enough extra material should be left on the sides to be folded and stapled shut. For example, if the main underdrain is 10 feet wide and four feet high, the filter cloth should be 30 feet wide.

Width of Filter Cloth = top + bottom + sides + stapling strip

= 10 + 10 + (4 + 4) + 2
= 30 feet

Six inches of rock should be dumped into the trench, then it should be filled with riprap. The exposed cloth should be folded over the rock and stapled shut every six inches.

2) Layered Drain. Only the trench bottom should be lined with filter cloth. Six inches of sand or gravel should be dumped into the trench. Then three layers of rock should be dumped into the trench. Each layer should be a different size, as determined by the mining engineer. The largest stone should be dumped first, the smallest last. The riprap should be covered with another layer of sand and gravel, until the top of the underdrain is level with the ground. The drain should be covered with a sheet of filter cloth. The cloth should be staked into solid ground on one-foot centers.

Smaller, lateral drains should be built from every seep or spring. Depending of the flow, these may be constructed using the same methods used for a main underdrain or with a plastic, perforated pipe wrapped in filter cloth. Holes should be cut in the filter cloth and lateral drains connected to the main underdrain. The cloth should be stapled at the points of connection.

Pipe Underdrains. For fills less than 250,000 cubic yards in volume, perforated pipe underdrains may be approved on individual basis, if fill failure would not result in stream blockage or create a public health or safety hazard. Pipe underdrains must be made of corrosion-resistant material and protected from clogging and contamination by a filter system.

Rock-Core Chimney Drains. A rock-core chimney drain (Figure 24) may be used in a head-of-hollow fill in place of the subdrain and surface water diversion system as long as the fill is not located in an area containing an intermittent or perennial stream. Rock-core chimney drains are permissible for use in valley fills that do not exceed 250,000 cubic yards in volume.

In constructing a chimney drain, a durable rock vertical core with a minimum thickness of 16 feet must be built to extend from the toe of the fill to the head of the fill and from the base of the fill to the surface of the fill. A system of lateral rock underdrains should connect this rock core to each area of potential drainage or seepage within the disposal area (405 KAR 16:130, Section 3). A filter system should be designed to ensure long-term functioning of the rock core.

The grading of the rock core may drain water away from the outslopes of the fill and toward the rock core. In no case may intermittent or perennial streams be diverted into the rock core.

The maximum slope of the graded fill surface may be 33h:1v (3 percent). Terraces on the fill shall be graded with a three- to five-percent slope toward the fill or a 1 percent slope toward the rock core.

A depression may be graded into the head of the fill during and after construction for the purpose of intercepting and collecting surface water runoff. This water would then be discharged through or over the rock drain, if approved by the Cabinet. In no case should such an impoundment exceed a volume in excess

of 10,000 cubic feet of water. The rock chimney drainage must be capable of accommodating a 100-year, 24-hour precipitation event.

Fill Construction

In general, three methods of fill construction exist:

- Horizontal, layered placement and compaction.
- Gravity placement -- end-dumped fills.
- Disposal on existing benches.

Selection of the appropriate method is site dependent, and should be specified in the MRP.

Horizontal, Layered Placement and Compaction. The primary method used to construct permanent disposal sites for excess spoil is the process of horizontal, layered placement and compaction. In this method, horizontal lifts should not exceed four feet in thickness. Exceptions to the four-foot rule may be made with Cabinet approval when fill consists of hard rock spoil. To construct the fill, work should start at the toe of the fill, and the fill should be built in an uphill direction. Each layer should be compacted. The fill should be inspected and evaluated for stability under the supervision of a professional engineer throughout the construction process. The long-term static safety factor of the fill must be at least 1.5.

Grading of the top of the fill should result in a slope steeper than 20h:1v (5 percent) toward drainage. Surface runoff from the top surface of the fill must not flow over the outslope of the fill (405 KAR 16:130, Section 1). The fill outslope may not exceed 2h:1v (50 percent) or that slope necessary to ensure stability of the fill.

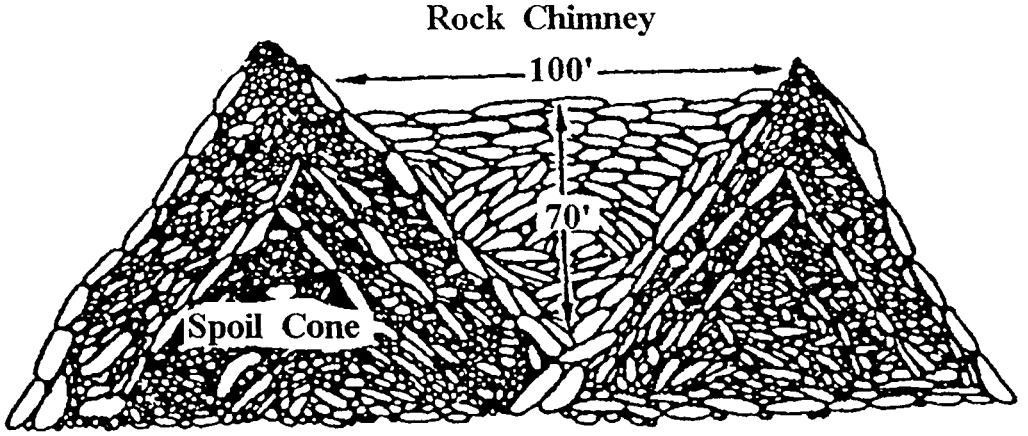

Figure 24. Schematic cross section of 70-foot-deep, V-shaped rock chimney for infiltration basin.

Terrace benches may be constructed on the outslope for the purpose of erosion control, enhanced stability, to preserve soil moisture, or to meet the post-mining land use. The benches should be graded with a 3- to 10-percent slope toward the fill. The outslope between terraces should not exceed 2h:1v (50 percent).

Gravity Placement -- End-Dumped Fills. Durable rock spoil may be disposed of in single or multiple lifts via gravity placement if the excess spoil is nonacid- and non-toxic-forming and is at least 80

percent (by volume) free of non-durable material (e.g., coal, clay, poorly cemented shale). The fill must meet a static safety factor of 1.5 and a minimum earthquake safety factor of 1.1. It may be possible to construct the underdrain system at the time of spoil placement through the natural gravity segregation of materials. If this method of drainage construction is not adequate to meet the 100-year, 24-hour precipitation event requirement, the underdrain may need to be constructed separately.

Disposal on Existing Benches. When the MRP specifies that spoil is to be disposed of on existing mined benches, only the solid portion of the bench should be used. Excess spoil should be transported and placed in horizontal lifts and concurrently compacted to ensure a long-term static safety of 1.3. Grading should be performed in a manner that encourages surface and subsurface drainage compatible with the existing terrain. The pre-existing bench should be backfilled and graded to achieve the most moderate slope possible. Highwalls should be eliminated to that extent practicable. Disposal from an upper bench to a pre-existing lower bench via gravity placement may be performed with Cabinet approval only. If approved, a safety berm must be constructed on the lower bench of sufficient dimension to prevent the gravity transport to the downslope.

MAINTENANCE

The fill and associated structures must be inspected under the supervision of a professional engineer. During all stages of construction, the disposal site must yield a static safety factor of 1.5 (1.3 in cases where disposal occurs on existing benches). Fills should be inspected after each rainfall. Ponding, or erosion in the form of rills exceeding nine inches, should be corrected through regrading. Any indications of slumping or sliding should be reported immediately to the mining engineer.